I. Introduction And Qualifications

1. My name is Nicholas S. Economides. I am a Professor of Economics at the Stern School of Business of New York University, located at 44 West 4th Street New York, NY 10012.

2. I received a B.Sc. degree in Mathematical Economics (first class honors) from the London School of Economics in 1976, a Masters degree in Economics from the University of California at Berkeley in 1979 and a Ph.D. degree in Economics from Berkeley in 1981, specializing in Industrial Organization.

3. From 1981 to 1988, I was assistant and then associate professor of economics at Columbia University. From 1988 to 1990, I was associate professor of economics at Stanford University. I have taught at the Stern School of Business since 1990. During the academic year 1996-1997, I was visiting professor at Stanford University.

4. I have published more than seventy research papers in the areas of industrial organization, microeconomics, network economics, antitrust, finance, and telecommunications policy, and I have given numerous seminar presentations at academic and government institutions and conferences. I have published academic research articles in the *American Economic Review*, the *RAND Journal of Economics*, the *International Journal of Industrial Organization*, the *International Economic Review*, the *Journal of Economic Theory*, and the *Journal of Industrial Economics*, among others. I am currently editor of the *International Journal of Industrial Organization* and of *Netnomics*. I have served as advisor and consultant to major telecommunications companies, a number of

the Federal Reserve Banks, the Bank of Greece, and major Financial Exchanges. I teach graduate (MBA and Ph.D.) courses in antitrust, industrial organization, microeconomics, and telecommunications. A copy of my *curriculum vitae* is attached as Attachment 1.

5. I have been asked by MCI WorldCom to examine the issue of competition on the Internet as it relates to the proposed merger between MCI WorldCom and Sprint. I have also been asked to comment on issues raised by Professor Hausman in his submission filed on behalf of SBC.

II. Summary Of Conclusions

6. I have reached the following conclusions. The structure of the Internet today precludes any single firm from achieving a dominant position in the provision of Internet backbone services. Specifically, the conditions necessary for a single firm to become a dominant provider of backbone services are not present in this industry segment. Further, the network externalities associated with the Internet strengthen the incentives of backbone providers to interconnect with other providers.

7. A complete examination of the current market environment of the Internet dispels any likelihood of harm arising from the merger. Multihoming, caching, mirroring, and intelligent content delivery undermine the incentive and ability of a substantial provider of Internet backbone services to raise the price of transit or degrade its interconnection arrangements with other backbone providers. It would not be profitable for the merged company to attempt to engage in degradation, or other strategies hypothesized by opponents to the merger, each of which would require the merged company to impair the quality of service to its own customers.

III. Network Externalities And The Internet

8. The issue of network externalities on the Internet has been central in the criticism of the proposed merger. Some suggest that, in an industry that exhibits network externalities, irrespective of features of market structure and without consideration to the specifics, a winner-take-all outcome, that is, monopoly, is inevitable. A few critics see the proposed merger of MCI WorldCom and Sprint as the next-to-final step in the establishment of monopoly on the Internet.[1] I believe that these conclusions are incorrect. They are based on ideas drawn from other industries and different market conditions that do not fit the Internet.

9. The Internet is a network of interconnected networks. Like any network it exhibits network externalities. Network externalities are present when the value of a good or service to each consumer rises as more consumers use it, everything else being equal.[2] In traditional telecommunications networks, the addition of a customer to the network increases the value of a network connection to all other customers, since each of them can now make an extra call. On the Internet, the addition of a user potentially

(i) adds to the information that all others can reach;

(ii) adds to the goods available for sale on the Internet;

(iii) adds one more customer for e-commerce sellers;

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[1] In this declaration, the term MCI WorldCom includes UUNET, the subsidiary that provides Internet services.

[2] See Nicholas Economides, "The Economics of Networks," *International Journal of Industrial Organization* (1996), vol. 14, no. 2, pp. 675-699; Joseph Farrell and Garth Saloner, "Standardization, Compatibility, and Innovation," *Rand Journal of Economics* (1985), vol. 16, pp. 70-83; Michael Katz and Carl Shapiro, "Network Externalities, Competition and Compatibility," *American Economic Review*, vol. 75, no. 3 (1985), pp. 424-440; S. J. Liebowitz and Stephen E. Margolis, "Network Externality: An Uncommon Tragedy," *The Journal of Economic Perspectives* (Spring 1994), pp. 133-150.

(iv) adds to the collection of people who can send and receive e-mail or otherwise interact in through the Internet.

Thus, the addition of an extra computer node increases the value of an Internet connection to each connection.

10. In general, network externalities arise because high sales of one good make complementary goods more valuable. Network externalities are present not only in traditional network markets, such as telecommunications, but also in many other markets. For example, an IBM-compatible PC is more valuable if there are more compatible PCs sold because then there will be more software written and sold for such computers.

11. In networks of interconnected networks, there are large social benefits from the interconnection of the networks and the use of common standards. A number of networks of various ownership structures have harnessed the power of network externalities by using common standards. Examples of interconnected networks of diverse ownership that use common standards include the telecommunications network, the network of fax machines, and the Internet. Despite the different ownership structures in these three networks, the adoption of common standards has allowed each one of them to reap huge network-wide externalities.

12. For example, users of the global telecommunications network reap the network externalities benefits, despite its fragmented industry structure. If telecommunications networks were not interconnected, consumers in each network would only be able to communicate with others on the same network. Thus, there are strong incentives for every network to interconnect with all other networks so that consumers enjoy the full extent of the network externalities of the wider network.

13. The Internet has very significant network externalities. As the variety and extent of the Internet's offerings expand, and as more customers and more sites join the Internet, the value of a connection to the Internet rises. Because of the high network externalities of the Internet, consumers on the Internet demand universal connectivity, that is, to be able to connect with every web site on the Internet and to be able to send electronic mail to anyone. This implies that every network must connect with the rest of the Internet in order to be a part of it. With competitive organization of the Internet's networks, the rising value is shared between content providers and telecommunications services providers (in the form of profits) and end users (in the form of consumer surplus).

14. The existence of common interconnection standards and protocols in the telecommunications and the network of fax machines has guaranteed that no service provider or user can utilize the existence of network externalities to create and use monopoly power. Similarly, the existence of common and public interconnection standards on the Internet guarantees that no service provider or user can utilize the existence of network externalities to create and use monopoly power based on proprietary standards.

A. Pro-Competitive Consequences Of Network Externalities

15. The presence of network externalities does not generally imply the existence of monopoly power. Where there are network externalities, adding connections to other networks and users adds value to a network, so firms have strong incentives to interconnect fully and to maintain interoperability with other networks. Thus, network externalities can act as a strong force to promote competition for services based on interconnected networks. For example, various manufacturers compete in producing and

selling fax machines that conform to the same technical standards and are connected to the ever-expanding fax network. It would be unthinkable that a manufacturer, however large its market share, would decide to produce fax machines for a different fax network that would be incompatible with the present one. In contrast, firms would like to conform to existing standards and fully interconnect to a network so that they reap the very large network externalities of the network.

16. The incentive to interconnect and to conform to the same standard applies similarly to competitive firms as it applies to firms with market power. Although, as in other markets, firms involved in network businesses may sometimes have market power, that power does not arise automatically from the network, even in the presence of externalities.

B. Conditions Under Which Network Externalities May Inhibit Competition

17. In markets with network externalities, firms may create bottleneck power by using proprietary standards. A firm controlling a standard needed by new entrants to interconnect their networks with the network of the incumbent may be in a position to exercise market power. Often a new technology will enter the market with competing incompatible standards. Competition among standards may have the snowball characteristic attributed to network externalities.

18. For example, VHS and Beta, two incompatible proprietary standards for video cassette recorders ("VCRs"), battled for market share in the early 1980s. Because Sony, the sponsor of the Beta standard, chose a pricing and licensing strategy that did not

trigger the snowball effect, VHS was the winner. In particular, Sony refused to license its Beta standard, while VHS was widely licensed.

19. Even though VHS was the winning standard, the market for VCRs did not become a monopoly since there are a number of suppliers of VHS-type video equipment. Thus, a standard may be licensed freely or at a low cost, and therefore the existence of a proprietary standard does not preclude competition. Moreover, in many cases a sufficiently open licensing policy will help to win the standards battle, and may therefore be in the interest of the owner of the standard to freely license even its proprietary standards.[3]

20. Economics literature has established that using network externalities to affect market structure by creating a bottleneck requires three conditions:[4]

(i) Networks use proprietary standards;

(ii) No customer needs to reach nodes of or to buy services from more than one proprietary network;

(iii) Customers are captives of the network to which they subscribe and cannot change providers easily and cheaply.

First, without proprietary standards, a firm does not have the opportunity to create the bottleneck. Second, if proprietary standards are possible, the development of proprietary standards by one network isolates its competitors from network benefits, which then

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[3] See Nicholas Economides, "Network Externalities, Complementarities, and Invitations to Enter," *European Journal of Political Economy*, vol. 12 (1996), pp. 211-233.

[4] See Nicholas Economides, "The Economics of Networks," *International Journal of Industrial Organization* (1996), vol. 14, no. 2, pp. 675-699; Nicholas Economides, "Desirability of Compatibility in the Absence of Network Externalities," *American Economic Review*, vol. 79, no. 5 (1989), pp. 1165-1181; Joseph Farrell and Garth Saloner, "Standardization, Compatibility, and Innovation," *Rand Journal of Economics*, vol. 16 (1985), pp. 70-83; Michael Katz and Carl Shapiro, "Network Externalities, Competition and Compatibility," *American Economic Review*, vol. 75 no. 3 (1985), pp. 424-440.

accrue only to one network. The value of each proprietary network is diminished when customers need to buy services from more than one network. Third, the more consumers are captive and cannot easily and economically change providers, the more valuable is the installed base to any proprietary network. The example of snowballing network effects I mentioned—VHS against Beta —fulfills these three conditions. I show next that these conditions fail in the context of the Internet backbone.

IV. Network Externalities And Competition On The Internet

A. Conditions Necessary For The Creation Of Bottlenecks Fail On The Internet

21. The Internet fails to fulfill any of the three necessary conditions under which a network may be able to leverage network externalities and create a bottleneck.

22. First, there are no proprietary standards on the Internet, so the first condition fails. The scenario of standards wars is not at all applicable to Internet transport, where full compatibility, interconnection, and interoperability prevail. For Internet transport, there are no proprietary standards. There is no control of any technical standard by service providers and none is in prospect. Internet transport standards are firmly public property.[5] As a result, any seller can create a network complying with the Internet standards -- thereby expanding the network of interconnected networks -- and compete in the market.

23. In fact, the existence and expansion of the Internet and the relative decline of proprietary networks and services, such as CompuServe, can be attributed to the

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[5] See Robert E. Kahn and Vinton G. Cerf, "What Is The Internet (And What Makes It Work)," (December 1999), at http://www.wcom.com/about_the_company/cerfs_up/internet_history/whatIs.phtml . Also see Scott Bradner, *The Internet Standards Process*, revision 3, Network Working Group (ftp://ftp.isi.edu/in-

conditions of interoperability and the tremendous network externalities of the Internet. America On Line ("AOL"), CompuServe, Prodigy, MCI and AT&T folded their proprietary electronic mail and other services into the Internet. Microsoft, thought to be the master of exploiting network externalities, made the error of developing and marketing the proprietary Microsoft Network ("MSN"). After that product failed to sell, Microsoft re-launched Microsoft Network as an Internet Service Provider, adhering fully to the public Internet standard. This is telling evidence of the power of the Internet standard and demonstrates the low likelihood that any firm can take control of the Internet by imposing its own proprietary standard.

24. Second, customers on the Internet demand *universal connectivity*, so the second condition fails. Users of the Internet do not know in advance what Internet site they may want to contact or to whom they might want to send e-mail. Thus, Internet users demand from their Internet Service Providers ("ISPs") and expect to receive universal connectivity. This is the same expectation that users of telephones, mail, and fax machines have: that they can connect to any other user of the network without concern about compatibility, location, or, in the case of telephone or fax, any concern about the manufacturer of the appliance, the type of connection (wireline or wireless) or the owners of the networks over which the connection is made. Because of the users' demand for universal connectivity, ISPs providing services to end users or to web sites must make arrangements with other networks so that they can exchange traffic with *any* Internet customer.

25. Third, there are no captive customers on the Internet, so the third condition fails, for a number of reasons:

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notes/rfc2026.txt), section 1.2.

(i) ISPs can easily and with low cost migrate all or part of their transport traffic to other network providers;

(ii) Many ISPs already purchase transport from more than one backbone to guard against network failures and for competitive reasons ("multihoming");

(iii) Many large web sites / providers use more than one ISP for their sites ("customer multihoming");

(iv) Competitive pressure from their customers makes ISPs agile and likely to respond quickly to changes in conditions in the backbone market.

B. Bottlenecks Such As The Ones Of The Local Exchange Telecommunications Network Do Not Exist On The Internet

26. There are significant differences between local telephone networks and the Internet which result in the existence of bottlenecks in local telephone markets and lack of bottlenecks on the Internet. Until the passage of the Telecommunications Act of 1996, the local telephone company had a legal franchise monopoly over local telephony in its territory in most States. Most importantly, the local telephone company monopolizes the fixed wireline connection to customers, especially the residential ones, thereby controlling the bottleneck for access to customers. Such a bottleneck does not exist on the Internet backbone. A number of reasons contribute to this:

(i) the cost of connecting an ISP to the rest of the Internet is very low compared to the cost of connecting every house to local telephone service;

(ii) the location of an ISP is not predetermined, but can be placed most conveniently within a geographic area;

(iii) the elasticity of supply for Internet transport services is high, that is, there are no barriers to expansion;

(iv) there are negligible barriers to entry on the Internet;

(v) Internet demand growth and expansion are exponential, driven by expanding market and geographic penetration and by the introduction of new applications.[6]

27. The only bottleneck in the Internet arises out of the control of the first/last mile of the local telecommunications network by incumbent local exchange carriers, since this first/last mile is used by the majority of users to connect to the Internet.

28. In summary, an analysis of network externalities shows that network effects cannot create barriers to entry for new networks on the Internet or barriers to expansion of existing ones. I also showed that network effects on the Internet do not create a tendency to dominate the market or tip it toward monopoly. On the contrary, network effects are a *pro-competitive force* on the Internet, providing strong incentives to incumbents to interconnect with new entrants. In the next sections I discuss in detail competition on the Internet.

V. Competition Among Internet Backbone Service Providers

A. Interconnection

29. The Internet is a network of interconnected networks. Interconnection is necessary to provide universal connectivity on the Internet that is demanded by users. Internet networks interconnect in two ways:

(i) Private bilateral interconnection; and

(ii) Interconnection at public Network Access Points ("NAPs").

The NAPs run by MCI WorldCom are called Metropolitan Area Exchanges ("MAEs").

30. In the last few years, the number of NAPs has grown dramatically. In 1995, there were only 5 NAPs, MAE East, MAE West, NY (Sprint), Chicago (Ameritech), and Palo Alto (PacBell). In 1999, there were 41 NAPs in the United States (including 5 MAEs), and 40 European NAPs (including 2 MAEs) and 27 Asia-Pacific NAPs.[7]

31. Private interconnection points and public NAPs are facilities that provide collocation space and a switching platform so that networks are able to interconnect. NAPs' services are not substitutes for ISP or for transport services. Rather they are a complement to ISP services and to transport services. NAPs allow networks to interconnect more easily by providing the necessary space and platform.

32. Interconnection at NAPs is governed by bilateral contracts of the parties. Some NAPs, such as the London Internet Exchange (LINX) facilitate such negotiations by posting a set of common rules and standard contracts which may be used by its members in their bilateral negotiations.

33. Interconnection of two networks X and Y at a NAP is governed by a contract between networks X and Y. MCI WorldCom does not dictate the terms of the contract and is not party to the contract unless it is one of the interconnecting networks. In particular, interconnection at a NAP owned or controlled by MCI WorldCom does not imply or require a barter (peering) or transit arrangement between UUNET and networks X and Y.

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[6] Demand grows yearly at about 100%. The number of north American ISPs more than tripled in 3 years.

[7] Source: http://www.ep.net.html.

B. The Transit And Peering Payment Methods For Connectivity

34. Internet networks have contracts that govern the terms under which they pay each other for connectivity. Payment takes two distinct forms, (i) payment in dollars for "transit"; and (ii) payment in kind, i.e., barter, called "peering." Connectivity arrangements among ISPs encompass a seamless continuum, including ISPs that rely exclusively on transit to achieve connectivity, ISPs that use only peering to achieve connectivity, and everything in between. Although there are differences between transit and peering in the specifics of the payments method, and transit includes services to the ISP not provided by peering, it should be made clear that these two are essentially alternative payment methods for connectivity.[8]

35. Under transit, a network X connects to network Y with a pipeline of a certain size, and pays network Y for allowing X to reach all Internet destinations. Under transit, network X pays Y to reach not only Y and its peers, but also any other network, such as network Z by passing through Y, as in the diagram below.

X-----------Y-=-=-=-=-=-Z

36. Under peering, two interconnecting networks agree not pay each other for carrying the traffic exchanged between them as long as the traffic originates and terminates in the two networks. Referring to the diagram above, if X and Y have a peering agreement, they exchange traffic without paying each other as long as such traffic terminating on X originates in Y, and traffic terminating on Y originates in X. If Y were

[8] Transit customers receive services, such as customer support, DNS services, etc., that peering networks do not receive.

to pass to X traffic originating from a network Z that was not a customer of Y, Y would have to pay a transit fee to X (or get paid a transit fee by X), i.e., it would not be covered by the peering agreement between X and Y.

37. Although the networks do not exchange money in a peering arrangement, the price of the traffic exchange is not zero. If two networks X and Y enter into a peering agreement, it means that they agree that the cost of transporting traffic from X to Y and vice versa that is incurred within X is roughly the same as the cost of transporting traffic incurred within Y. These two costs have to be roughly equal if the networks peer, but they are not zero.

38. The decision as to whether interconnection takes the form of peering or transit payment is a commercial decision. Peering is preferred when the cost incurred by X for traffic from X to Y and Y to X is roughly the same as the cost incurred by Y for the same traffic. If not, the networks will use transit. As I will explain below, the decision of whether to peer or not depends crucially on the geographic coverage of the candidate networks.

39. Generally, peering does not imply that the two networks should have the same size in terms of the numbers of ISPs connected to each network, or in terms of the traffic that each of the two networks generate.[9] If two networks, X and Y, are similar in terms of the types of users to whom they sell services, the amount of traffic flowing across their interconnection point(s) will be roughly the same, irrespective of the relative size of the networks. For example, suppose that network X has ten ISPs and network Y has one ISP.

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[9] For example, MCI WorldCom has peering arrangements with a number of smaller networks. See Letter from Sue D. Blumenfeld, Attorney for Sprint Corporation, and A. Richard Metzger, Jr., Attorney for MCI WorldCom, Inc. to Magalie Roman Salas, FCC, CC Docket No. 99-333 (dated Jan. 14, 2000) ("Supplemental Internet Submission") at page 20.

If all ISPs have similar features, the traffic flowing from X to Y is generally equal to the traffic flowing from Y to X.[10]

40. What determines whether a peering arrangement is efficient for both networks is the *cost* of carrying the mutual traffic within each network. This cost will depend crucially on a number of factors, including the geographic coverage of the two networks. Even if the types of ISPs of the two networks are the same as in the previous example (and therefore the traffic flowing in each direction is the same), the cost of carrying the traffic can be quite different in network X from network Y. For example, network X (with the ten ISPs) may cover a larger geographic area and have significantly higher costs per unit of traffic than network Y. Then network X would not agree to peer with Y. These differences in costs ultimately would determine the decision to peer (barter) or receive a cash payment for transport.

41. Where higher costs are incurred by one of two interconnecting networks because of differences in the geographic coverage of each network, peering would be undesirable from the perspective of the larger network. Similarly, one expects that networks that cover small geographic areas will only peer with each other. Under these assumptions, who peers with whom is a consequence of the extent of a network's geographic coverage, and does not have any particular strategic connotation.

42. In summary, whether two interconnecting networks use peering (barter) or cash payment (transit) does not depend on the degree of competition among backbone services

[10] Suppose the larger network has ten ISPs with ten web sites per ISP and a total of 1,000 users, and it interconnects with a smaller network with one ISP with ten web sites and a total of 100 users. For simplicity, suppose that every user visits every web site. Then the smaller network transmits 100 X 10 X 10 = 10,000 site-visits to the larger network, and the larger network transmits 1,000 X 1 X 10 = 10,000 site-visits to the smaller network. Thus, the traffic across networks of different sizes is the same if the types of ISPs and users are the same across networks.

providers. In particular, the presence of peering is not necessarily a sign of intense or weak competition nor would the replacement of peering by cash pricing necessarily be a sign of diminished or increased competition.

43. Opponents of the MCI WorldCom - Sprint merger have characterized a refusal to peer and charging instead of a transit payment as an anti-competitive act. However, the analysis above shows that generally, an ISP's decision not to peer reflects its assessment that the average costs of transport within one network are larger than the average costs of transport within the other network. Thus, refusal to peer is not inherently an anti-competitive act; it is a consequence of some networks being much larger than others in terms of geographic coverage.

C. Internet Backbone Services

44. Users connect to the Internet either by dialing their ISP, connecting through cable modems, residential DSL, or through corporate networks. Typically, routers and switches owned by the ISP send the caller's packets to a local Point of Presence "POP" of the Internet.[11] Dial-up, cable modem, and DSL access POPs as well as corporate networks dedicated access circuits connect to high speed hubs. High speed circuits, leased from or owned by telephone companies, connect the high speed hubs forming an "Internet Backbone Network." See Figure 1, attached as attachment 2.

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[11] Small ISPs may not own routers and switches, but rather just aggregate traffic at modem banks and buy direct access to a larger ISP.

45. Backbone networks provide transport and routing services for information packets among high speed hubs on the Internet. Backbone networks vary in terms of their geographic coverage. Boardwatch magazine lists the following national backbones.[12]

@Home Network	Intermedia Business Internet
1 Terabit	Internet Access/GetNet
Abovenet	Internet Services of America
Apex Global Information Services (AGIS)	IXC Communications, Inc
AT&T Networked Commerce Services	Level 3
Cable & Wireless USA	MCI WorldCom — Advanced Networks
CAIS	MCI WorldCom — UUNET
Concentric	NetRail
CRL Network Services	PSINet, Inc.
Digital Broadcast Network Corp	Qwest/Icon CMT
Electric Lightwave	Rocky Mountain Internet/DataXchange
EPOCH Networks, Inc.	Savvis Communications Corporation
e.spire	ServInt
Exodus	Splitrock Services
Fiber Network Solutions	Sprint IP Services
Frontier Global Center	Teleglobe
Globix	Verio
GTE Internetworking	Visinet

[12] See http://www.boardwatch.com/isp/summer99/backbones.html. Boardwatch magazine also lists 348 regional backbone networks.

<u>GST Communications</u>

<u>IBM Global Services</u>

<u>ICG/Netcom Online</u>

<u>IDT Internet Services</u>

<u>Vnet</u>

<u>Winstar/Broadband</u>

<u>ZipLink</u>

46. The transport and routing that backbone networks offer do not necessarily differ depending on whether cash (transit) or barter (peering) is used for payment. The same transport and routing between customers of the two networks can be obtained by purchase or through barter for other transport services. Even if one assumes the relevant product market is Internet backbone services, the market cannot possibly be defined in terms of the method of payment.

D. Conduct of Internet Backbone Service Providers

1. Pricing Of Transport Services In The Backbone Networks

47. I first discuss business conduct of Internet backbone service providers. Structural conditions for Internet backbone services (discussed in the next section) ensure negligible barriers to entry and expansion and easy conversion of other transport capacity to Internet backbone capacity. As discussed in the next section, raw transport capacity, as well as Internet transport capacity have grown dramatically in the last four years. Transport capacity is a commodity because of its abundance.

48. The business environment for Internet backbone services is competitive. Generally, ISPs buying transport services face flexible transit contracts of relatively short

duration. Backbones do not impose exclusivity of service on their customers. UUNET not require that it be the exclusive Internet transport provider to its ISP customers.

49. Often an ISP buys from a backbone bandwidth of a certain capacity that allows it to connect to the whole Internet (through a "transit" payment). The bandwidth capacity and speed of the connecting pipe vary widely and depend on the demand for transport that an ISP wants to buy from a particular backbone. Price lists for various bandwidth capacities are printed in Boardwatch magazine. The strength of competition among the various backbone providers is evidenced in the small or non-existent differences in the prices for various bandwidth capacities. Table 1 shows the prices for AT&T and UUNET (MCI WorldCom) for various bandwidth capacities as reported by the latest edition of Boardwatch magazine (August 1999). Despite the fact that AT&T's backbone business is significantly smaller than UUNET's, their prices are identical for most bandwidths, and when they differ, the differences are very small. Many other providers of various sizes have very similar prices as reported in Boardwatch magazine.

Table 1: Comparison Of Early 1999 Prices For US T3s [13]

Service	**AT&T**	**UUNET**	**Price Difference = UUNET-AT&T**
Burstable 0-6 Mbps	$12,500	$12,000	$ - 500
Burstable 6.01 - 7.5 Mbps	$14,000	$14,000	$0
Burstable 7.51 - 9 Mbps	$17,000	$17,000	$0
Burstable 9.01-10.5 Mbps	$19,000	$19,000	$0
Burstable 10.51-12 Mbps	$22,000	$22,000	$0
Burstable 12.01 - 13.5 Mbps	$26,000	$26,000	$0
Burstable 13.51 - 15 Mbps	$29,000	$29,000	$0

[13] Source: Boardwatch Magazine's Directory of Internet Service Providers, 11th Edition, 1999.

Burstable 15.01 - 16.5 Mbps	$32,000	$32,000	$0
Burstable 16.51 - 18 Mbps	$37,000	$37,000	$0
Burstable 18.01-19.5 Mbps	$43,000	$43,000	$0
Burstable 19.51-21 Mbps	$48,000	$48,000	$0
Burstable 21.01 - 45 Mbps	$55,000	$55,500	$ 500

50. Professor Hausman argues that the exit of AOL as a provider of backbone services shows that it does not find it economical to self supply, and that this is an indication of lack of competition among backbone service providers.[14] This an incorrect interpretation. AOL's decision not to operate its own backbone shows that AOL is convinced that there is and there will continue to be competition among Internet backbone service providers to furnish transport service to ISPs. Moreover, if AOL had any doubts about the strong competition among backbone service providers in the future, it would have kept ownership of its backbone as insurance against potential anti-competitive actions by IBPs. Thus, AOL's decision shows that it believed that the market was competitive at the time and that AOL expected it to remain competitive in the long run.

2. <u>ISP Multihoming; Additional Demand Responsiveness To Price Changes</u>

51. ISPs are not locked in by switching costs of any significant magnitude. Thus, ISPs are in good position to change providers in response to any increase in price, and it would be very difficult for a backbone profitably to increase price. Moreover, a large percentage of ISPs has formal agreements that allow them to route packets through more

than one backbone networks and are able to control the way the traffic will be routed (multihoming). Table 2 shows that, in 1999, additional (i.e., second or subsequent) connections sold to multihoming ISPs amounted to 43% of all ISP connections to backbones. One of the reasons for the increase in multihoming is likely the decrease in the cost of multihoming. Recently the cost of customer routers that are required for ISP multihoming has decreased from $10,000 to $2,000 - $3,000.[15] An additional reason for an ISP to multihome is that multihoming increases the ability of the ISP to route its traffic to the lowest-priced backbone, as discussed below.

52. When an ISP reaches the Internet through multiple backbones, it has additional flexibility in routing its traffic through any particular backbone. A multihoming ISP can easily reduce or increase the capacity with which it connects to any particular backbone in response to changes in prices of transit. Thus, multihoming increases the firm-specific elasticity of demand of a backbone provider. Therefore, multihoming severely limits the ability of any backbone services provider profitably to increase the price of transport. Any backbone increasing the price of transport will face a significant decrease in the capacity bought by multihoming ISPs.

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[14] See Declaration of Professor Jerry Hausman on behalf of SBC ("Hausman Decl."), at ¶ 50.

[15] Source: Boardwatch Magazine's Directory of Internet Service Providers, 11th Edition, 1999.

Table 2: Additional Backbone Connections Held By Multihoming ISPs [16]			
Year	**# ISPs**	**Number Of Backbone Connections Sold To ISPs**	**Share Of Additional Connections Sold To Multihoming ISPs**
1997	4,354	5,739	24%
1998	4,470	5,913	24%
1999	5,078	8,950	43%

53. Large Internet customers also use multiple ISPs (customer multihoming). They have chosen to avoid any limitation on their ability to switch traffic among suppliers even in the very shortest of runs. Customer multihoming has similar effects as ISP multihoming in increasing the firm-specific elasticity of demand of a backbone provider and limiting the ability of any backbone services provider profitably to increase the price of transport.

54. New technologies of content delivery that utilize distributed storage of web-based content on various locations on the Internet reduce the need for backbone network transport. "Caching" stores locally frequently requested content. "Mirroring" creates a replica of a web site. Intelligent content distribution, implemented, among others, by Akamai Technologies,[17] places its servers closest to the end users inside an ISP's network. Intelligent content distribution technology assesses the fastest route on the Internet for content access, and delivers content faster to end users. Placing content

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[16] Sources: Boardwatch Magazine's Directory of Internet Service Providers, Fall 1997, p. 6. Boardwatch Magazine's Directory of Internet Service Providers, Winter 1998, p. 5. Boardwatch Magazine's Directory of Internet Service Providers, 11th Edition, 1999, p. 4. The last column is calculated as the difference between the third and the second columns divided by the third column, for example, for 1999, (8950-5078)/8950 = 43.26% rounded to 43%.

[17] Akamai was founded in 1998 and made a $234M initial public offering October 1999. Akamai has industry relationships with AT&T, BT plc, DIGEX, Global Center, GTEI, Lycos, Microsoft, PSINet, Qwest, RealNetworks, Telecom Italia, Teleglobe, Universo Online, UUNET, and Yahoo!, among others.

delivery close to end users and optimizing content delivery intelligent content distribution, caching, and mirroring reduces in effect the demand for Internet transport services and the ability of backbone providers to affect the transit price.

VI. Structural Conditions For Internet Backbone Services; Negligible Barriers To Entry And Expansion

A. The Markets For Raw Transport Capacity And Other Inputs To Internet Transport Services

55. Almost all Internet transport uses fiber-optic transmission capacity which is based on a well-known and easily available technology.[18] There are no significant barriers to entry in the supply of additional raw transmission capacity. Fiber transmission capacity is essentially fungible, and the same physical networks can be used for the transmission of voice, Internet traffic, and data by using different protocols.

56. Fiber that will not be needed by an Internet transport supplier can be leased or sold for non-Internet uses. The same fiber and electronics are used for both circuit switched and packet switched networks which can each transport both voice and data. Before construction, the operator has a completely open choice between creating either a circuit switched or a packet switched network. Only the interface differs between voice and data applications. Once capacity is in place, there are small costs of converting from one use to the other. Moreover, capacity can be upgraded in small steps so that fiber networks can respond flexibly to increasing capacity requirements.

57. Fiber capacity is growing rapidly today and is expected to grow for the indefinite future. Because there is always a large amount of new capacity in the planning stage, no

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[18] The transport and switching technologies are available from firms that do not sell backbone transport or

operator needs to consider switching the use of existing capacity. As a result, fiber capacity is not in any way a barrier to entry in Internet transport.

58. In order to build or expand Internet backbone capacity, besides fiberoptic cable, networks need routers and switches. Routers and switches are readily available from a variety of third party suppliers. Fiber capacity can be leased, and there is no shortage of capacity that would constrain the ability of smaller networks or new entrants to expand capacity or enter the market. Fiber networks can add leased capacity or increase their capacity by deploying new technologies such as Dense Wave Division Multiplexing ("DWDM"). The construction of fourth-generation fiberoptic networks, deploying the latest technology, promises an abundance of capacity that appears to be able to accommodate the very rapid growth in capacity demand that has been the hallmark of the Internet market to date.

B. Evidence Of The Ease Of Expansion And Entry

59. National, international, and regional long haul fiber-optic transmission capacity has increased very rapidly, both as a result of expansion of networks of incumbents, such as AT&T, MCI WorldCom, and Sprint, but also as a result of entry of a number of carriers that created new networks. FCC's *Fiber Deployment Update* reports that total fiber system route miles of interexchange carriers increased by two-thirds between 1994 and 1998.[19] The rapid expansion of fiber optic capacity and the forecasts of very rapid future capacity growth are discussed in detail in the November 17, 1999, and March 20, 2000, declarations of Stanley Besen and Steven Brenner. I will only note very briefly

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ISP services.

[19] See Jonathan M. Kraushaar, *Fiber Deployment Update: End of Year 1998*, FCC, Industry Analysis

that capacity expansion is increasing at an accelerated rate. For example, between 1997 and 1998, long haul fiber optic capacity increased by 27%. Qwest completed 18,815 route miles, Williams 26,000 route miles, IXC/Broadwing 15,000 route miles, Frontier 12,000 route miles and GTE 17,000 route miles. Level 3, Teleglobe, Enron, Cable & Wireless are building nationwide networks, while Caprock, McLeodUSA, GST Telecom and others are building substantial regional networks.[20] There is no doubt that entry in the long haul market is easy and that the capacity of long haul fiber is increasing in an accelerated rate.

60. As evidence of ease of entry, the number of North American ISPs more than tripled in the last three years. The number of North American backbone providers has grown almost fivefold in 3 years. These statistics are shown in tables 3 and 4.

Table 3: Growth Of ISP Industry [21]	
Number Of North American ISPs	**Date**
1447	February 1996
2266	May 1996
3747	April 1997
4354	October 1997
5078	1999

Division, Common Carrier Bureau, Table 1.

[20] See Declaration of Stanley Besen and Steven Brenner, March 20, 2000.

[21] Source: Boardwatch magazine, Fall 1997, and 11th edition, Fall 1999.